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# TM-77, MD-77 MULTIPLEXER

## OPERATING MANUAL

IOA77-1G  
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**List of abbreviations**

AACK	Alarm Acknowledgement
ACK	Alarm Acknowledged
AIS	Alarm Inhibition Signal
AISL	AIS from Local interface
AISR	AIS from Remote device
BBE	Background Block Error
ES	Errored Second
ES15	15 Minutes Errored Second Counter
ES24	24 Hours Errored Second Counter
ESFE	Errored Second Far End
ETSI	European Telecommunications Standards Institute
GND	Ground
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LDF	Laser Diode Failure
LOESx	Loss of Electrical Signal
LOF	Loss of Frame
LOOS	Loss of Optical Signal
LOS	Loss of Signal
NUAL	Non-Urgent Alarm
NUALA	Non-Urgent Alarm Relay
UALA	Urgent Alarm Relay Urgent
RAL	Remote Alarm
SES	Severely Errored Second
SES15	15 Minutes Severely Errored Second Counter
SES24	24 Hours Severely Errored Second Counter
SESFE	Severely Errored Second Far End
SESFE15	15 Minutes Far End Severely Errored Second Counter
SESFE24	24 Hours Far End Severely Errored Second Counter
UA	Urgent Alarm
UAL	Urgent Alarm
UAS	Unavailability Second
VIOL	Violation

## **Operating safety**

TM-77.1 and MD-77.1 devices have been designed and tested for the operating safety in accordance with Class I of PN-EN 60950 standard.

**The device has no built-in disconnecting system. Such a system should be installed outside the device.**

**When the device is supplied from a DC source, an easily accessible disconnecting system should be mounted into the fixed cabling outside the device.**

**Radiation transmitted by the laser transmitter is harmful to eyes!**



**Never look at the uncovered socket without a plugged-in fiber optic connector.**

**The Manufacturer is not responsible for the use of the device in a manner non-compliant with the operating manual.**

**This Operating Manual is an integral part of the device delivered to the Users.**

## **1 OVERALL CHARACTERISTICS**

### **1.1 Application**

TM/MD-77 linear circuit device enables full duplex transmission of four digital signals at the bit rate of 2.048 Mbit/s in accordance with ITU-T G.703 via a fiber optic line.

TM/MD-77 devices can operate with PCM-30 terminal equipment, telephone switches or other optional signal sources at the bit rate of 2.048 Mbit/s equipped with the same interface.

The devices are completely transparent for the content of the transmitted signal; it can be a non-framed or framed signal - provided it complies with the requirements of the G.703 recommendation.

All TM-77, MD-77, TM-76, MD-76 and TM-44 devices can operate with each other if connected via a fiber optic line. If TM/MD-77 4-channel device is connected to MD-76 or TM-76 single-channel device, transmission with the first E1 channel is possible.

The optical signal can be transmitted via a couple of single-mode or gradient optical fibers depending on the version of the device.

Transmission via SM fiber can be realized with devices equipped with LASER type transmitter.

**Transmission via MM fiber can be realized only with devices equipped with both LED and LASER type transmitters.**

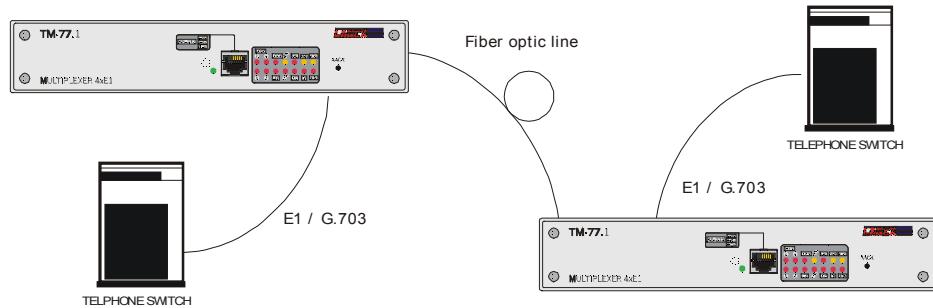
### **1.2 Basic features**

**Table 1. Basic features of the devices**

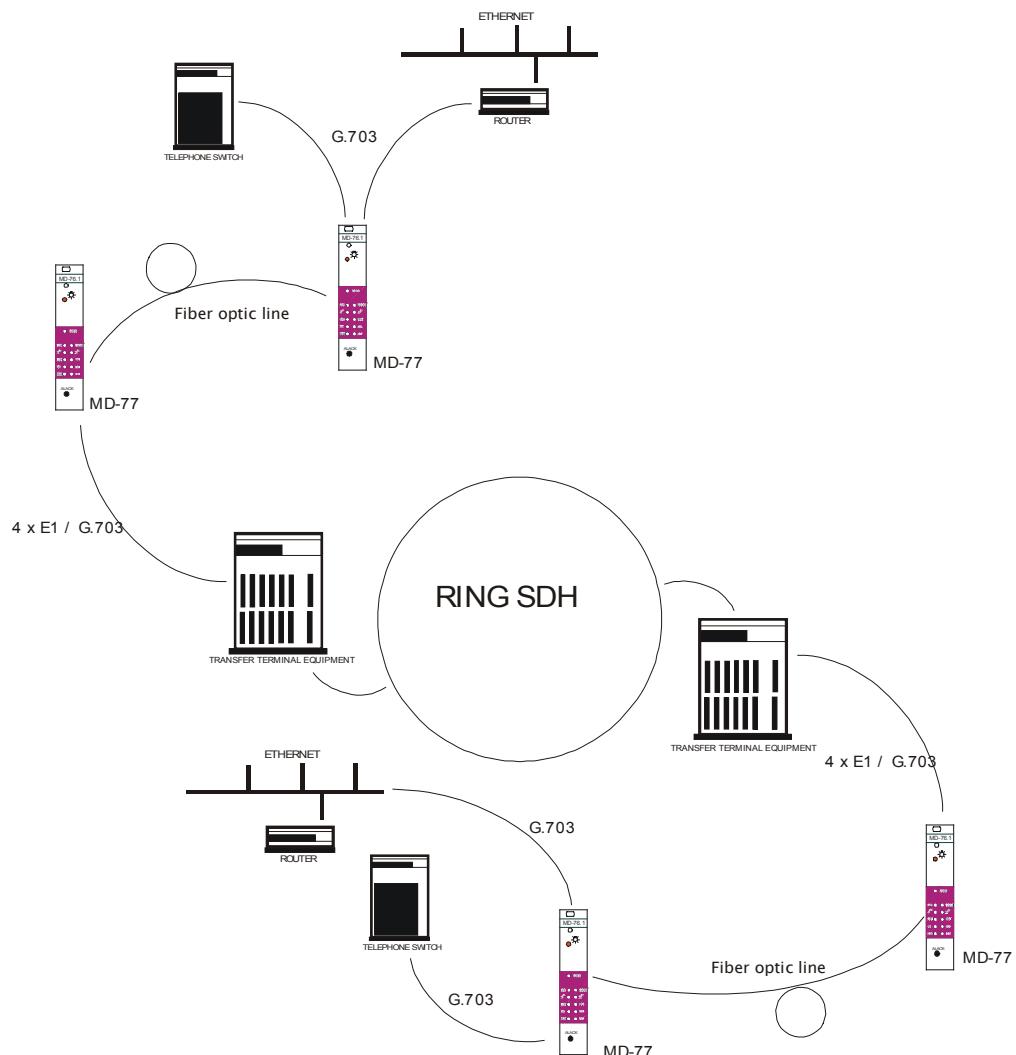
Symbol	Electrical ports	Optical ports	Version	Management	Power supply
MD-77	4 ports conforming to ITU-T-G.703, 2.048 Mbit/s, DSUB-25 connector	2x SC	card to TM-72 telecommunication rack	MD-91 supervision module in TM-72 rack	18÷60V DC
TM-77			desktop version	RJ-45 connector	36÷60V DC 230V AC

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## 1.3 Examples of application

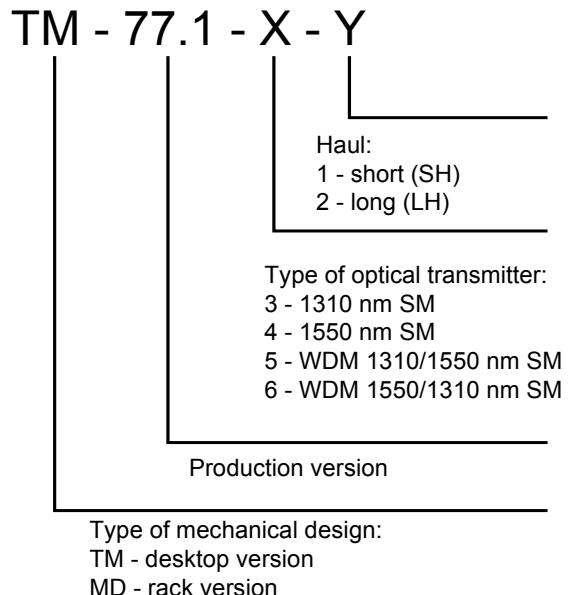


**Figure 1.** TM-77.1 multiplexers used in telephone networks



**Figure 2.** MD-77 multiplexers used to connect telephone switches and computer networks using SDH network

#### 1.4 Symbols and available versions



Type of mechanical design:

TM - desktop version

MD - rack version

#### List of abbreviations:

SH – short haul

LH – long haul

MM – designed for operate with multi-mode fiber

SM - designed for operate with single-mode fiber

WDM – version to operate with single fiber, using WDM (Wavelength Division Multiplexing) technology

1310 nm - transmitter working with 1310 nm wavelength, receiver working with 1310 nm wavelength

1550 nm - transmitter working with 1550 nm wavelength, receiver working with 1550 nm wavelength

1310/1550 nm - transmitter working with 1310 nm wavelength, receiver working with 1550 nm wavelength

1550/1310 nm - transmitter working with 1550 nm wavelength, receiver working with 1310 nm wavelength

E1 multiplexer is available in two versions:

- as a desktop version in a metal casing, symbol TM-77.
- as a card installed in TM-72 telecommunication rack to cooperate with another TM-72 or MD-77 card.

Symbol example:

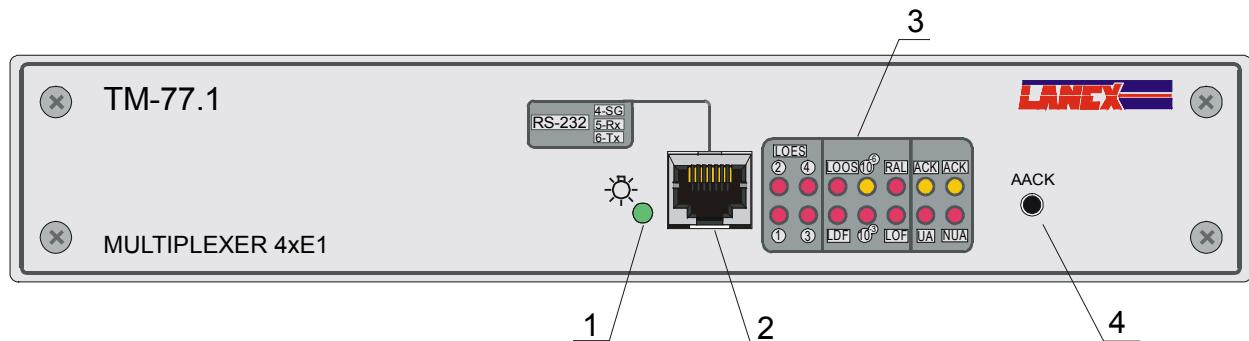
TM-77.1-3 – a desktop multiplexer equipped with a laser transmitter of 1310 nm wavelength.

*Note:* 1. *Each time a symbol containing the letter "X" instead of its corresponding digit is used in the Manual, it means that the feature specified in this part of the symbol is insignificant concerning the discussed parameter and may be equal to any value from the above-mentioned range. However, the device symbol indicated in a sales order must contain only digits following the manufacturer symbol "TM" or "MD" (all features of the ordered device must be specified).*

## 2 CONNECTORS AND INDICATORS

### 2.1 Introduction

Device versions differ from each other with the type of the used optical elements. There are no differences in the mechanical structure.



### 2.2 TM-77 multiplexer

1 - power supply indication diode

2 - supervision connector

3 - group of signaling diodes:

LOES – loss of E1 interface input signal

LOOS – loss of optical receiver input signal

LDF – laser diode failure (loss of optical transmitter output power)

LOF – loss of frame synchronization of received signal

$10^{-3}$  – error rate  $10^{-3}$  exceeded

$10^{-6}$  – error rate  $10^{-6}$  exceeded

RAL – remote alarm

group of alarm condition signaling diodes:

UA – urgent alarm

ACK – acknowledgement of urgent alarm

NUA – non-urgent alarm

ACK – acknowledgement of non-urgent alarm

4- AACK – alarm acknowledgment button

**Figure 3.** View and description of TM-77 front panel

The device is equipped with V.28 interface enabling multiplexer management from VT100 terminal level. The interface is described in Table 2.

**Table 2.** Description of RS-232 / V.28 DCE connector outputs (RJ-45 type)

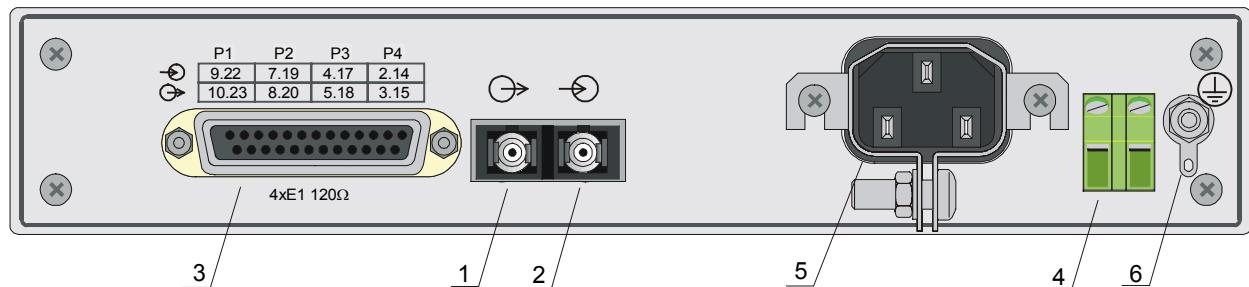
Pin	Description	
4	SGND	
6	Tx	OUT
5	Rx	IN

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RS-232 cable should be used to connect TM-77 multiplexer to the terminal. Table 3 specifies the required list of cable connections.

**Table 3.** PC computer (terminal) to TM-77 connecting cable specification

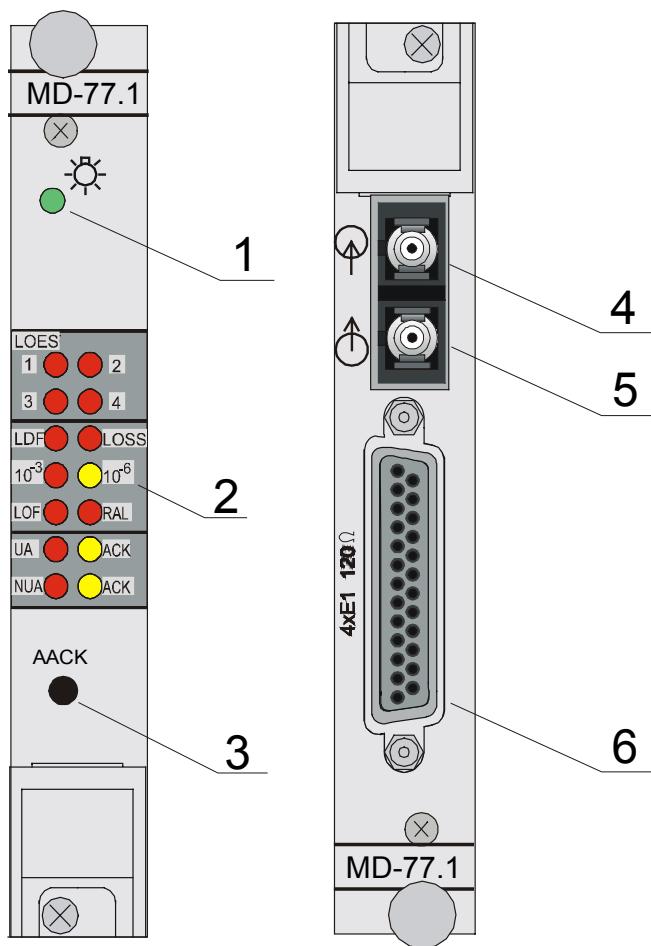
TM-77.1 multiplexer side		PC computer or terminal side	
RJ-45 connector	Pin symbol	DSUB-9 female connector	DSUB-25 female connector
6	Tx	2	3
5	Rx	3	2
	RTS – CTS	7 – 8	4 – 5
	DTR - DSR	4 – 6	6 – 20
4	SGND	5	7



- 1 - optical receiver output
- 2 - optical receiver input
- 3 - 120Ω symmetric linear signal inputs/outputs - DSUB-25 connector
- 4 - connector with a screw mounting to connect 36÷60V DC power supply source
- 5 - connector with a screw mounting to connect 230V AC power supply source
- 6 - grounding terminal

**Figure 4.** View and description of device rear panel

### 2.3 MD-77 multiplexer (card)



**Figure 5.** View of TM-77.1 front and rear panels

1 - power supply indication diode

2 - group of signaling diodes:

LOESn – loss of electrical signal coming in n-channel

LOOS – loss of optical receiver input signal

LDF – laser diode failure (loss of optical transmitter output power)

LOF – loss of frame synchronization of the received signal

$10^{-3}$  – error rate  $10^{-3}$  exceeded

$10^{-6}$  – error rate  $10^{-6}$  exceeded

RAL – remote alarm

group of alarm condition signaling diodes:

UA – urgent alarm

ACK – acknowledgement of urgent alarm

NUA – non-urgent alarm

ACK – acknowledgement of non-urgent alarm

3- AACK – alarm cancellation button

4- optical receiver input

5- optical receiver output

6 120 Ω symmetric linear signal input/output - DSUB-25 connector

### **3 FUNCTIONAL DESCRIPTION**

TM-77 and MD-77 devices perform the following functions:

1. processing of electrical signals at the bit rate of 2.048 Mbit/s in HDB-3 three-level code into a digital signal in the natural code;
2. multiplexing of four data streams at the bit rate of 2.048 Mbit/s according to the G.742 recommendation;
3. encoding in 5B/6B code;
4. processing an electrical signal into an optical one;
5. receiving of an optical signal and processing it into an electrical signal;
6. decoding of a data stream encoded in 5B/6B code;
7. demultiplexing of four data streams at the bit rate of 2.048 Mbit/s;
8. encoding of a data stream at the bit rate of 2.048 Mbit/s in HDB-3 code;
9. control and signaling of the basic parameters of the multiplexer operation and generation of alarms in the event of failures.

#### **3.1 Diagnostic and signaling systems**

TM-77 and MD-77 type devices automatically control the parameters of E1/G.703 local interface and linear optical signal, and detect and signalize the following conditions and values:

G.703 E1 local interface

- loss of interface input signal
- receiving of AIS signal coming from E1 interface
- receiving of AIS signal coming from demultiplexer
- HDB3 code violation

Linear optical interface:

- loss of linear input signal
- loss of frame synchronization of the received signal
- block error rates  $1 \times 10^{-3}$  and  $1 \times 10^{-6}$  exceeded
- receiving of the AIS bit in G.742 frame signaling a remote alarm

An alarm condition is indicated as follows:

- appropriate local interface LED is switched on: LOES
- appropriate optical interface LED is switched on: LOOS, LOF,  $10^{-3}$ ,  $10^{-6}$ , RAL, LDF
- shorting of UALA, NUALA alarm relay terminals in TM-72 telecommunication rack.

When a failure is detected, a "non-urgent" alarm – NUA (indicating a failure condition, which does not interrupt transmission) or an "urgent" alarm – UA (meaning a transmission interruption - an immediate operator's response is necessary) is generated.

MD-77 device card signalizes generation of an urgent or non-urgent alarm by sending a signal to activate the alarm relays in TM-72 rack. The urgent and non-urgent alarm signaling relay contacts in the telecommunication rack are connected to DSUB- 9 female socket. The detected failure conditions and actions taken are shown in Table 1.

**Table 4.** Detected failure conditions and accompanying actions.

Failed element	Failure condition	Alarm	Actions taken									G.742 frame bit
			LED diode					Relay <sup>1)</sup>	E1 channel signal			
			LOOS	LOF	$10^{-3}$	$10^{-6}$	LDF		RAL	LOES	UA	NUA
Linear optical interface	Loss of signal	UA	*						C	O	AIS signals are transmitted to all E1 interfaces	*
	Loss of frame synchronization	UA		*					C	O	AIS signals are transmitted to all E1 interfaces	*
	Error rate $> 10^{-3}$	UA		*				O	C	AIS signals are transmitted to all E1 interfaces	*	
	Error rate $> 10^{-6}$	NUA			*			C	O	---		
	Transmitter failure	UA				*					---	
	Remote alarm					*					---	
Local interface E1 G.703, G.704	Loss of signal	UA					*	C	O	AIS signal is transmitted via E1 channel to multiplexer		
Entire device	Loss of power supply	UA						C	C	—		

\* – LED diode is on

<sup>1)</sup> – alarm relay, an activated alarm is indicated by closed relay contacts (C – closed contacts, O – open contacts). TM-77.1 version is not equipped with alarm relays.

### 3.2 Additional channels

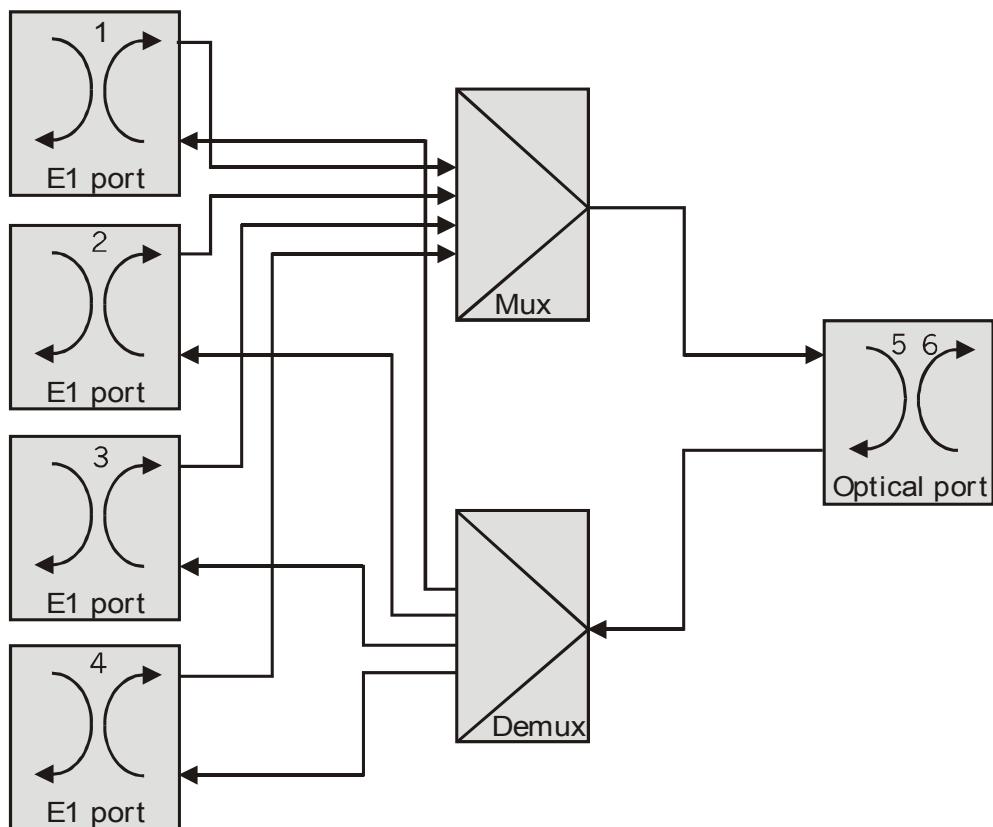
A frame is generated in the multiplexing system. The frame includes two bits, which are used to generate two additional synchronous bidirectional data transmission channels at the speed of 10 kbit/s each.

The first of the bits – Alarm Indication Signal Bit - is used to transmit an alarm signal to a remote device.

The other bit - National Bit - is used for communication between the supervision systems of a local and remote device.

### 3.3 Test loops

TM-77.1 and MD-77.1 device software enables closing a loop on E1 electric interface and optical interface in the direction to and from the device. Concerning E1 interface, both loops are closed at the same time. The figure below shows possible loops. A loop number is consistent with the number used in the device software.



**Figure 6.** Loops

### 3.4 Clock transfer

TM-77 and MD-77 devices are based on a plesiochronous multiplexer compliant with ITU-T G.742 standard. 2Mbit/s signals received on G.703 E1 electric interfaces are transmitted separately. E2 linear optical interface collective signal clock is also separate from the clock signals generated in E1 interface. The requirement is that the clock signal frequency restored on E1 interface must be in accordance with ITU-T G.703 recommendation (2048 MHz  $\pm$  50ppm).

### **3.5 Event log**

TM-77 and MD-77 devices can record the time and date of an event of a specified criterion. The devices record the following types of events:

- an appearance or loss of power supply voltage,
- an appearance or loss of G.703 E1 interface input signal,
- an appearance or loss of AIS signal transmitted from a unit connected to E1 interface or connected to E1 channel with E2 collective signal,
- an appearance or loss of E2 optical interface input signal,
- a gain or loss of G.742 frame synchronization on E2 optical interface,
- exceeding or going below  $10^{-3}$  error rate threshold on E2 optical interface,
- exceeding or going below  $10^{-6}$  error rate threshold on E2 optical interface,
- exceeding or going below a user-defined ES 15-minute errored second counter (ES15) threshold – there is a separate counter for each interface,
- exceeding or going below a user-defined ES 24-hour errored second counter (ES24) threshold – there is a separate counter for each interface,
- exceeding or going below a user-defined SES 15-minute severely errored second counter (SES15) threshold – there is a separate counter for each interface,
- exceeding or going below a user-defined SES 24-hour severely errored second counter (SES24) threshold – there is a separate counter for each interface,
- activation or deactivation of test loops,
- approval of a device set-up modification,
- an attempt of unauthorized access to the device set-up system using VT100 terminal emulator, if the system is password-protected.

Reviewing and deleting the event log as well as defining maximum and minimum threshold values for ES15,24 and SES15,24 counters of E1 and E2 interfaces is possible with the **Lanwin** application or VT100 terminal emulator described in sections 5.5.4 *Event log* and 6.6.1 *Event log*.

### **3.6 Monitored qualitative parameters of G.703 E1 interface**

TM-77 and MD-77 devices are provided with a function of qualitative parameter monitoring. The devices automatically monitor the interface signal parameters and detect, count and signalize the following conditions and parameters:

#### **Indicators:**

- LOES - loss of electrical signal
- VIOL - HDB3 code violation on G.703 E1 optical interface
- AISL - AIS signal detection on G.703 E1 interface
- AISR - AIS signal detection in E1 flux demultiplexed from E2 collective channel.
- ES15 - exceeding a 15-minute errored second counter threshold
- SES15 - exceeding a 15-minute severely errored second counter threshold
- ES24 - exceeding a 24-hour errored second counter threshold
- SES24 - exceeding a 24-hour severely errored second counter threshold

#### **Counters:**

- ES15 - 15-minute errored second counter
- SES15 - 15-minute severely errored second counter
- ES24 - 24-hour errored second counter
- SES24 - 24-hour severely errored second counter
- BBE15 - 15-minute background block error counter
- BBE24 - 24-hour background block error counter
- UAS15 - 15-minute unavailability second counter
- UAS24 - 24-hour unavailability second counter

### **3.7 Monitored qualitative parameters of E2 optical interface**

TM-77 and MD-77 devices are provided with a function of qualitative parameter monitoring. The devices automatically monitor the linear interface signal parameters and detect, count and signalize the following conditions and parameters:

#### **Indicators:**

- LOOS - loss of optical signal
- LDF - laser diode failure
- LOF - loss of frame synchronization
- 10E-3 - error rate  $10^{-3}$  exceeded
- 10E-6 - error rate  $10^{-6}$  exceeded
- RAL - remote device alarm indicating a remote device connection failure (between a local and remote device)
- ES15 - exceeding a 15-minute errored second counter threshold
- SES15 - exceeding a 15-minute severely errored second counter threshold
- ES24 - exceeding a 24-hour errored second counter threshold
- SES24 - exceeding a 24-hour severely errored second counter threshold
- SESFE15 - exceeding a 15-minute severely errored second far end counter threshold
- SESFE24 - exceeding a 24-hour severely errored second far end counter threshold

#### **Counters:**

- ES15 - 15-minute errored second counter
- SES15 - 15-minute severely errored second counter
- ES24 - 24-hour errored second counter
- SES24 - 24-hour severely errored second counter
- SESFE15 - 15-minute severely errored second far end counter
- SESFE24 - 24-hour severely errored second far end counter
- BBE15 - 15-minute background block error counter
- BBE24 - 24-hour background block error counter
- UAS15 - 15-minute unavailability second counter
- UAS24 - 24-hour unavailability second counter

## **4 INSTALLATION AND OPERATION**

### **4.1 Operating conditions**

The devices can operate continuously in closed rooms and in conditions according to paragraph 7.4.1 of this *Operating Manual*. The devices should not be directly exposed to sunlight. Ventilation slots must not be plugged. We do not recommend to put the devices on heat sources, although they can be placed on another device of the same type or installed in a rack together with other devices. However, such an arrangement requires a free air flow or, if necessary, forced ventilation.

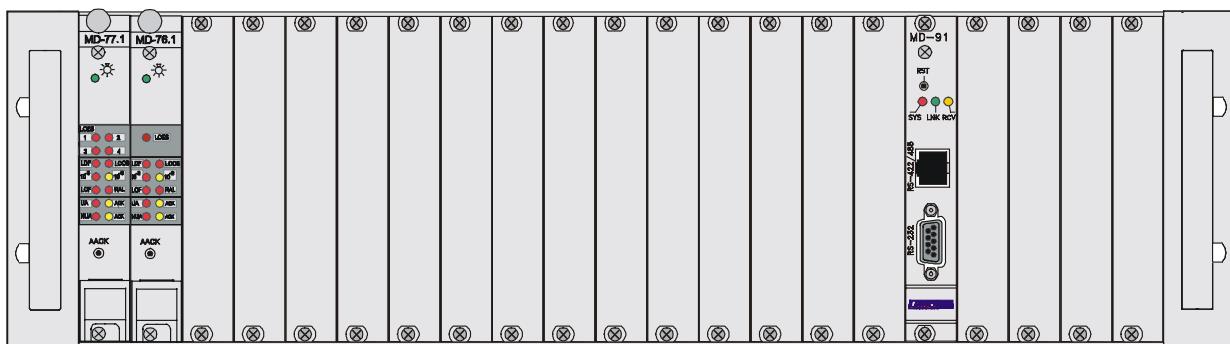
### **4.2 Installation**

TM-77 is a desktop device; MD-77 is installed in MD-72 telecommunication rack.

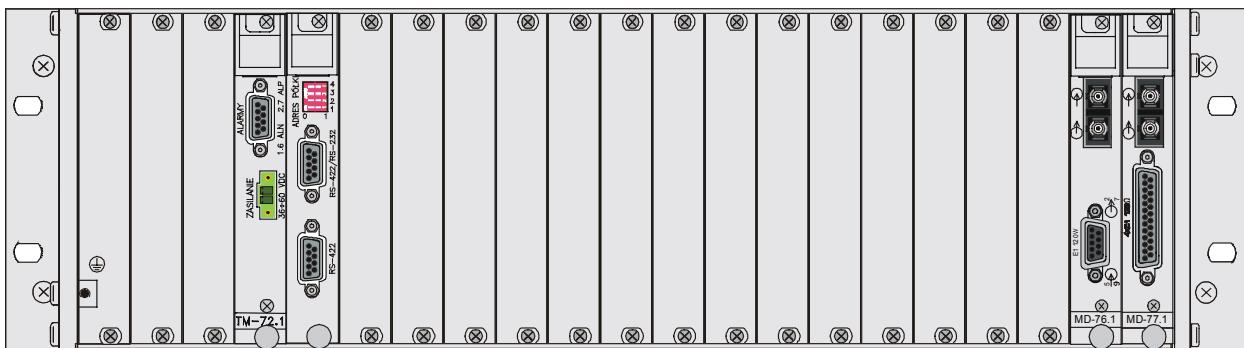
MD-77 device comprises a digital card and an interface card. The digital card is installed in the front part of the rack in slots 1÷16 and the interface card is installed in their corresponding slots in the rear part of the rack. The cards are equipped with pullers for easy assembly and disassembly in TM-72 rack. The cards can be installed in the rack without a need to turn off the power supply. There is no specific sequence of assembly of the digital card and interface card.

The figures below show the rack with the installed MD-77 card (slot 1), MD-77 card (slot 2) and MD-91 management module card (slot 17) enabling communication with the **Lanwin** management application.

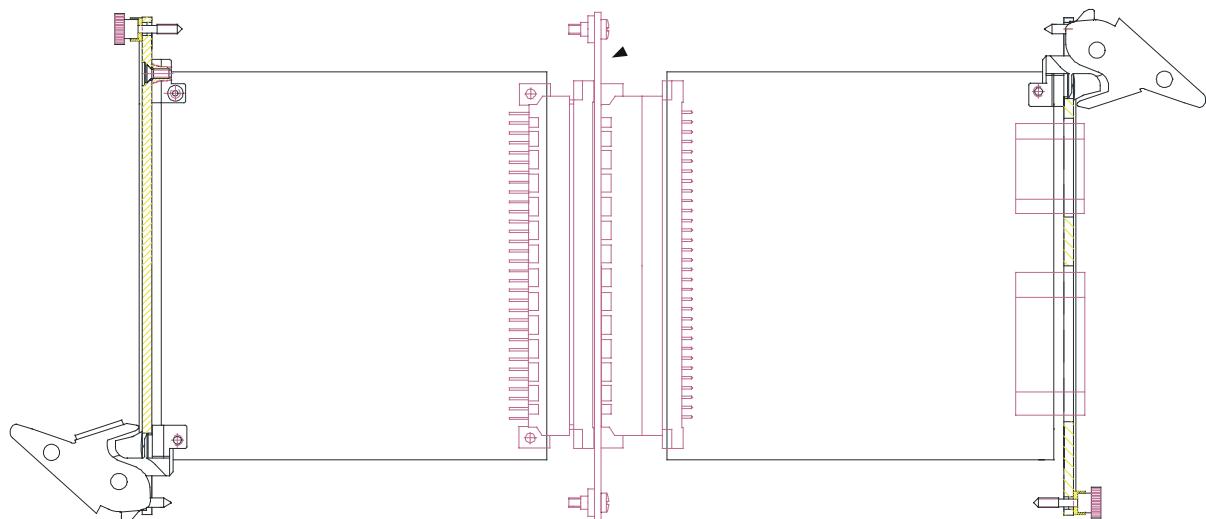
**The management module card can be installed in slot 17 only.**



**Figure 7.** Device installation in form of MD-72 telecommunication rack card, front view.



**Figure 8.** Device installation in form of MD-72 telecommunication rack card, rear view.



**Figure 9.** Installation of the devices in the form of a card in MD-72 telecommunication rack, sectional view.

### 4.3 Power supply

TM-77 multiplexer can be supplied with 36÷60V DC voltage or 230V AC voltage. MD-77 card is supplied with 18÷60V DC voltage from TM-72 telecommunication rack. Power supply connection is described in TM-72 rack operating manual. Power supply voltage parameters are given in paragraph 7.6.



**The correct power supply of the device is signalized by a light indicator on the front panel.**

36÷60V power supply unit voltage should be connected to the socket with external screw connections. There is no requirement concerning polarity of power supply voltage. The grounding should be connected to the grounding terminal on the casing. The grounding cable should have low impedance for high frequencies.

**Note.** The device has no built-in disconnecting system, thus an easily accessible disconnecting system should be mounted into the fixed cabling.

#### **4.4 E1/G.703 linear signal connection**

##### **4.4.1 TM-77 and MD-77**

E1/G.703 interface input and output signals of **TM-77 and MD-77** devices are transmitted via two screened symmetric cables of  $120 \Omega$  impedance or one double screened cable of the same impedance.

The following rules should be observed to meet the requirements concerning noise emissions. Symmetric cables should be connected using DSUB-25 plug equipped with a metal or metallized casing (shield) and the cable screen should be connected to the casing over the whole circumference. It is insufficient just to connect the screen to the "structural earth" terminals on the E1/G.703  $120\Omega$  interface socket.

The E1/G.703  $120 \Omega$  linear module socket outputs are described in Table 5.

**Table 5.** Description of TM-77 and MD-77 E1/G.703  $120\Omega$  interface outputs

Pin No.	Description of outputs
1	GND
2	RX_B4
3	TX_B4
4	RX_A3
5	TX_A3
6	GND
7	RX_B2
8	TX_B2
9	RX_A1
10	TX_A1
11	GND
12	GND
13	Not connected
14	RX_A4
15	TX_A4
16	GND
17	RX_B3
18	TX_B3
19	RX_A2
20	TX_A2
21	GND
22	RX_B1
23	TX_B1
24	GND
25	Not connected

#### **4.5 Connection to VT100 terminal or a computer with the installed Lanwin management software.**

TM-77 device is equipped with RS-232 interface enabling multiplexer management from the level of VT100 terminal or using the **Lanwin** software. The interface is described in Table 6.

**Table 6.** Description of RS-232 / V.28 DCE connector outputs (RJ-45 type)

Pin	Description	
4	SGND	
6	Tx	OUT
5	Rx	IN

RS-232 cable should be used to connect TM-77 multiplexer to the terminal. Table 7 specifies the required list of cable connections.

**Table 7.** TM-77 - computer connecting cable specification

TM-77.1 multiplexer side		PC computer or terminal side	
RJ-45 connector	Pin symbol	DSUB-9 female connector	DSUB-25 female connector
6	Tx	2	3
5	Rx	3	2
	RTS – CTS	7 – 8	4 – 5
	DTR - DSR	4 – 6	6 – 20
4	SGND	5	7

MD-76 and MD-77 cards in TM-72 rack can be managed with the **Lanwin** software installed on a PC computer. TM-72 rack must be equipped with MD-91 management card. The managing computer should be connected to the rack with the cable specified in the table below.

**Table 8.** TM-72 - computer connecting cable specification.

TM-72 rack MD-91 card side		PC computer or terminal side	
DSUB-9 connector (female)	Pin symbol	DSUB-9 female connector	DSUB-25 female connector
2	Tx	2	3
3	Rx	3	2
	RTS – CTS	7 – 8	4 – 5
	DTR - DSR	4 – 6	6 – 20
4	SGND	5	7
casing		casing	casing

#### 4.6 Fiber optic line connection

The maximum length of a fiber optic line to connect devices is not a unequivocal value because it depends on external factors, such as light pipe attenuation coefficient, through-connector attenuation as well as the accepted safety margin. The length, i.e. range can be determined by performing an optical power balance.

The power balance for the devices is shown in Table 9. The fiber optic line length calculated in the are maximum values for the adopted assumptions (maximum values from the cable catalog of the Optical Telecommunications Technology Center in Lublin are used as light pipe attenuation coefficients). When other assumption are used, the obtained values can be slightly different.

**Table 9.** Power balance

	Device version	77.1-3-1 LASER 1310 nm SH	77.1-3-1 LASER 1310 nm SH	77.1-3-2 LASER 1310 nm LH	77.1-4-1 LASER 1550 nm SH	77.1-5/6-1 WDM 1310/1550 nm SH	77.1-5/6-2 WDM 1310/1550 nm LH
1	Wave length (for WDM have been done calculation for unfavourable case - 1310 nm)	1310 nm	1310 nm	1310 nm	1550 nm	1310 nm	1310 nm
2	Type of optical fiber	SM	MM <sup>1)</sup>	SM	SM	SM	SM
3	Transmitter power level [dBm]	-15	-15	-5	-5	-14	-8
4	Receiver sensitivity [dBm]	-35	-35	-36	-35	-31	-34
5	Power budget (3-4) [dBm]	20	20	31	30	20	26
6	Power margin for devices [dB]	4	4	4	4	4	4
7	Power margin for cable [dB]	2	2	3	3	2	3
8	Light pipe attenuation coefficient [dB/km]	0,4	1	0,4	0,2	0,4	0,4
9	Through-connector average attenuation [dB]	0,1	0,2	0,1	0,1	0,1	0,1
10	Transmission range (5-6-7)/(8+9) [km]	28	12	48	77	22	38
11	Minimum line attenua- tion [dB]	0 dB	0 dB	0 dB	0 dB	0 dB	0 dB

<sup>1)</sup> The device can operate with multimode optical fibers.

TM-77 and MD-77 multiplexers can operate with a two-fiber optical line based - depending on version - on the optical fibers:

- 50/125 or 62.5/125 µm multimode optical fibers - with SC connector terminals;
- single-mode optical fibers - with SC/PC connectors (angle terminal connectors must not be used - their symbol usually includes APC marking).

A connection should be made with a double station cable or two single cables. The device should be positioned in such a manner that no forces - lateral or longitudinal - act on the connectors. A cable bend radius cannot be less than a value recommended by the manufacturer - it can be practically assumed as 50 mm.

Optical fiber connectors - particularly single-mode ones - are very precise components. That is why they should be handled with care, with no excessive forces when connecting and disconnecting them. Also the socket and the plug "ferrule" should be kept ideally clean. If dirty, the socket can be blown with clean compressed air, while the ferrule can be cleaned with isopropyl or ethyl alcohol (denatured alcohol must not be used). A piece of cloth, which does not leave fibers, should be used for this purpose.

*The diameter of the single-mode optical fiber core is only 9 μm. Thus any contamination particles of similar size may cause significant signal attenuation and completely disable transmission.*

If no optical fiber plugs are connected to the device, the sockets should be always secured with protective caps to avoid dust penetration.

The following steps should be performed to make a connection:

- remove the protective caps from the socket and the plug ferrule;
- put the ferrule into the socket end caring of accurate alignment of the socket and plug axes - any attempts of pushing the plug "obliquely" can damage the connector. Pay attention to place the key located on the plug circumference (outside the ferrule) in the notch in the socket;
- tighten the connector nut until slight resistance is felt.

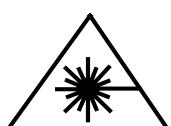
Please remember that the fiber optic line connected from one side to the optical transmitter - should be connected to the receiver from the other side. This fact will be indicated by the red diode "LOOS", which will go out. A reverse connection is not harmful but of course the devices will not function ("LOOS" diodes in both multiplexers will be on and AIS signal will be sent to E1/G.703 interfaces).

Any manipulations of fiber optic connectors may be performed when the power supply is on.

The optical transmitter may be connected to the receiver of the same multiplexer with a short section of an optical cable in order to close the "local loop" and take measurements.

**NOTE !**

***Radiation transmitted by the laser transmitter is harmful to eyes! It is indicated by the following symbol placed on the device:***



***Never look at the uncovered socket without a plugged-in fiber optic connector. The transmitter emits full power always when the device is on - with or without a signal connected to the electrical input.***

## **5 OPERATION WITH VT100 TERMINAL**

### **5.1 Application**

The supervision software is adapted to support VT100 terminal; it is used to set up and monitor the functions of TM-77 multiplexer. MD-77 device is installed in the rack and it does not have a contact enabling terminal connection.

The software provides the following features:

- Activation / deactivation of component channels;
- Installation of test loops in a local device
- ES, SES, UAS and BBE monitoring
- Monitoring the following events:
  - Loss of optical signal
  - Transmitter failure
  - Loss of frame synchronization
  - Alarm from a remote device
  - Loss of signal component
  - Exceeding  $10^{-3}$  error rate;
  - Exceeding  $10^{-6}$  error rate;
  - HDB3 code violation in a component channel
  - AIS signal detection on E1 interface
  - AIS signal detection in E1 flux demultiplexed from E2 collective channel
- Alarm status monitoring:
  - Active;
  - Inactive;
- Generation of event logs

### **5.2 Hardware requirements**

There are many programs enabling VT100 terminal emulation, which operate on various hardware platforms and support various operating systems. The most popular are **TERM95** included in Norton Commander package supporting DOS environment or **HYPERTERMINAL** supporting Windows (both for PC-class computers).

### **5.3 Installation and start-up**

In order to start up the supervision software, VT100 terminal or a VT100 terminal emulation program should be correctly set up.

The tables below show examples of **TERM95** and **HYPERTERMINAL** setup. If another program is used, the user should set the appropriate parameters based on the user manual of the program:

Transmission speed	9600
Data bits	8
Parity	none
Stop bits	1
Flow control	none
Emulation	VT100

**Table 10.** VT100 terminal settings for "TERM95" program

<b>TERM95</b>	
Speed	9600
number of data bits	8
number of stop bits	1
flow control	none
local echo	none
terminal type	VT100

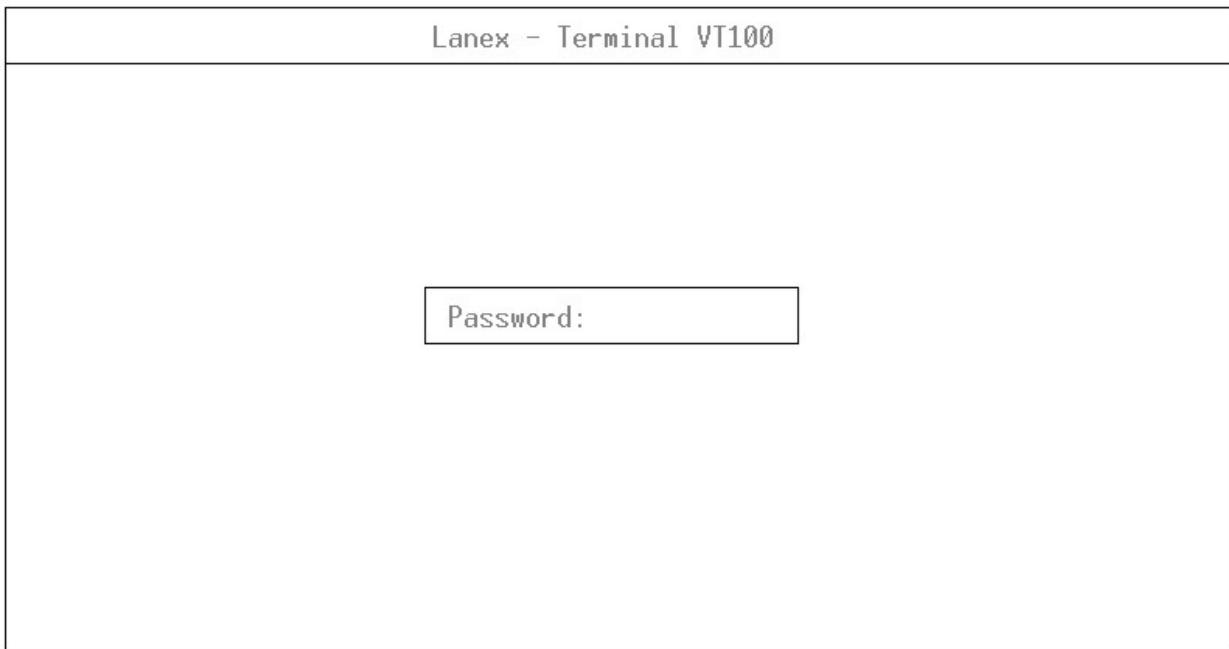
**Table 11.** VT100 terminal settings for "HYPER TERMINAL" program

<b>HYPERTERMINAL</b>	
bits per second	9600
Data bits	8
Parity	none
Stop bits	1
flow control	none
Font	terminal
local echo of entered characters	none

### **5.4 Beginning the terminal operation**

After the device is started up and RS-232 interfaces are connected, enter the **START** command and press the **ENTER** button. The command may be entered in small or capital letters.

When the command is identified, TM-77 opens the first window specifying the device type and its address. Then the password entry window opens. It allows the user to enter the password protecting from unauthorized access to the device. If the password is not active, it is sufficient to press **ENTER**.



**Figure 10.** Password entry panel

**EMERGENCY PASSWORD REMOVAL!!**

If the user forgets the password, he/she can remove it by performing an emergency procedure.

To do this, the user - instead of the password - should enter %code01. Then, the program will generate an 8-digit string, which should be submitted to the LANEX service. Based on the string, an emergency password will be generated enabling 12-hour access to the device. Within a period of 12 hours, the password allows the user to delete the old password and enter a new one.

### **5.5 Main menu**

The main menu is the entry window to all remaining panels and submenus. Submenus are selected with the ARROWS and ENTER keys.

From its level, you can access the following panels:

- System
- Interfaces
- Event log
- Monitoring
- Loops
- About the program



**Figure 11.** The Main menu

The operation needs only the ARROWS, BACKSPACE, SPACE, ENTER keys and a combination of some other keys, e.g. CTRL+X. The user is forced to "manually" exchange information with the terminal only when really necessary (entry and modification of clock, password, device name).

Each of the available panels comprises three fields (common to all panels). These are:

- panel name and date bar,
- device name and address bar,
- key shortcut bar.

1.	SYSTEM	2004.01.01	0:18:30_
2.	Name : TM-77.1	Local address: 014D00FB	Remote address: [REDACTED]
Device type : TM-77.1 Software version : 1.04 Hardware version : 1.02 Device hardw. address : 014D00FB (hex) Serial number : 0117 (dec)			
Device name : TM-77.1 Access password : NONE System time : 2004.01.01 0:18:30 Language : English Laser : FULL POWER Counters start time : 00:00			
3.	BkSp-Exit BkSp-Back Enter-Change up/down-move		

**Figure 12.** A terminal window example

1. active panel name and current date and system clock bar

SYSTEM	2004.01.01	0:18:30_
--------	------------	----------

2. device name and address bar

Name : TM-77.1	Local address: 014D00FB	Remote address: [REDACTED]
----------------	-------------------------	----------------------------

3. key shortcut bar indicating operations available in a given panel

BkSp-Exit BkSp-Back Enter-Change up/down-move
---

### 5.5.1 System

The System panel allows the user to:

- modify the device name,
- activate the password and enter a new one (you will be prompted to give the password during the terminal start-up)
- modify the system time and date,
- set the full or reduced laser power,
- specify the counting base time in 15-minute and 24-hour periods

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SYSTEM	2004.01.01	0:18:30
Name : TM-77.1	Local address: 014D00FB	Remote address: [REDACTED]
<hr/>		
Device type : TM-77.1 Software version : 1.04 Hardware version : 1.02 Device hardw. address : 014D00FB (hex) Serial number : 0117 (dec)		
Device name : TM-77.1 Access password : NONE System time : 2004.01.01 0:18:30 Language : English Laser : FULL POWER Counters start time : 00:00		
<hr/>		
BkSp-Exit BkSp-Back Enter-Change up/down-move		

**Figure 13.** The System panel

The parameters set up in the System panel are listed in Table 12.

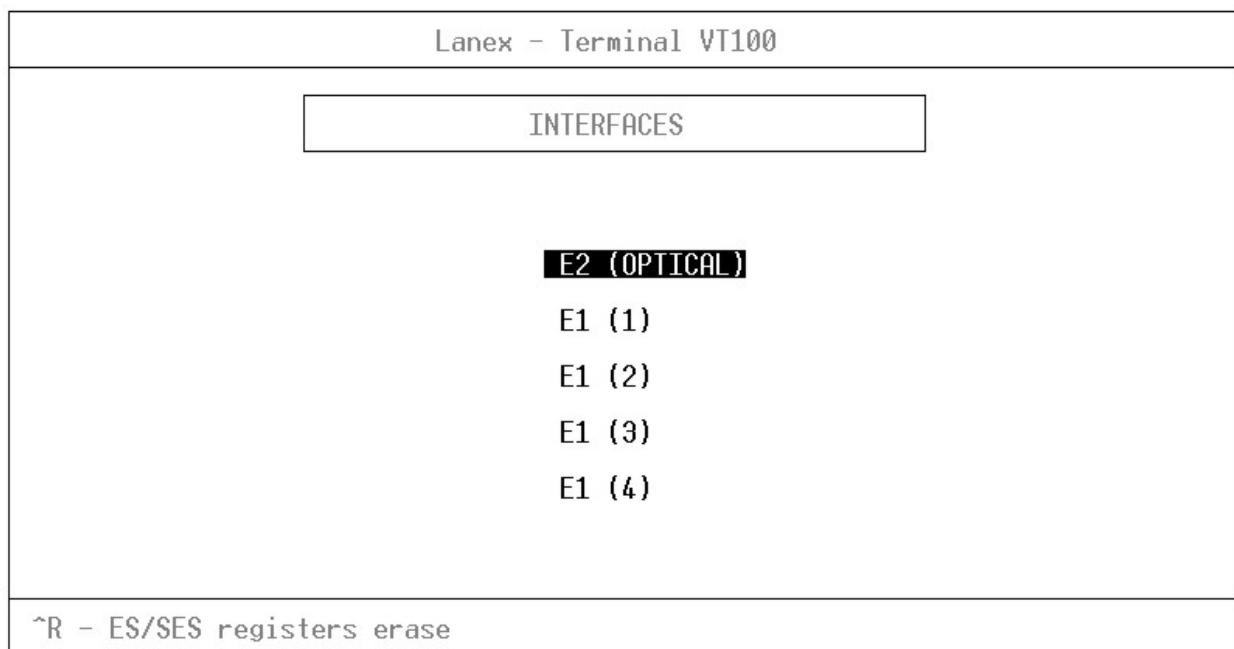
**Table 12.** Device set-up registers. The values in the gray fields in the table are given in the phase of production. Any subsequent modification by the user is impossible.

Parameter name	Allowed status	Default value	Description
Device type	TM - 77	---	Type of configured device
Software version	---	---	Device software version number
Hardware version	---	---	Device hardware version
Device address	---	---	Device address given in production
Serial No.	---	---	Number given to the device in production
<hr/>			
Device name	16 – character text	TM – 77.1	Any device name given by the user
Access password	8 – character text	---	Password protecting from unauthorized access to the device
System time	Digits for individual elements of date and time	---	System clock arrangement: Date – yyyy,mm,dd Time – hh,mm,ss
Language	Polish or English	Polish	Language selection
Laser	Full power	---	Laser transmitter operation status
Counting start	Two digits for hour and minute	00:00	Hour and minute of count start for ES and SES registers in the following arrangement: hh,mm

### 5.5.2 Interfaces-selection

This panel allows the user to select the interface to set up and monitor the quality parameters of the interface and its activation.

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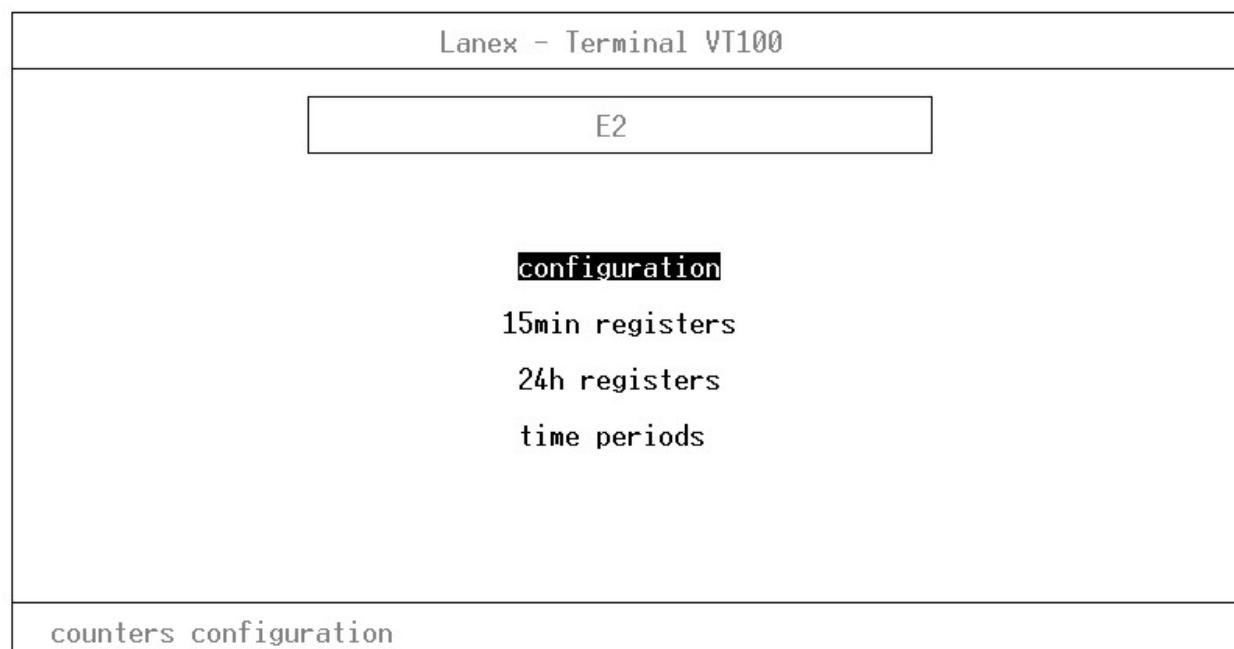


**Figure 14.** Interfaces-selection

**5.5.2.1 Interfaces-options**

The Interfaces-options panel is used to select the following panels:

- interface set-up,
- viewing 15-minut and 24-hour ES, SES, BBE, UAS, ESFE, SESFE registers,
- viewing the objects related to quality monitoring in the set periods



**Figure 15.** Interfaces-options

### 5.5.2.2 Set-up

The Set-up panel is used to:

- set up alarm severity levels when exceeding the quality thresholds in 15-minute and 24-hour periods, set up alarm switch-on and switch-off thresholds when exceeding the quality thresholds in 15-minute and 24-hour periods,
- set up alarm switch-on and switch-off thresholds when exceeding the quality thresholds in 15-minute and 24-hour periods

CONFIGURATION		2004.01.01	0:20:52
Name : TM-77.1		Local address: 014D00FB	Remote address: <b>NONE</b>
<hr/>			
counter	alarm	thresh(on)	thresh(off)
es15min :	NUAL	120	000
es24h :	NUAL	11520	00000
ses15min :	UAL	015	000
ses24h :	UAL	01440	00000
ses_fe_15min :	UAL	015	000
ses_fe_24h :	UAL	01440	00000
<hr/>			
BkSp-Exit Enter-Change ^D-Default left/right/up/down-move			

**Figure 16.** Interfaces - set-up

Alarm severity levels when exceeding the switch-on threshold can be as follows:

- UAL – urgent alarm,
- NUAL – non-urgent alarm
- NONE – no alarm is generated

A switch-on threshold defines the number of seconds, after exceeding of which an alarm specified by a severity level is activated.

A switch-off threshold defines the number of seconds, which specifies deactivation of an alarm specified by a severity level, if the counted number of seconds is less or equal to the threshold at the end of a given period.

The table below shows allowable alarm statuses (severity levels) and allowable values of alarm switch-on and switch-off thresholds when exceeding ES and SES threshold values.

**Table 13.** Interface set-up – alarm severity level values, switch-on and switch-off threshold values.

<b>Parameter name</b>	<b>Allowed status</b>	<b>Default value</b>	<b>Description</b>
ES/SES threshold exceeding alarm	Urgent alarm Non-urgent alarm None	Urgent alarm for SES counters Non-urgent alarm for ES counters	ES/SES threshold exceeding alarm activity
Threshold value of switching on an urgent alarm after SES was exceeded in a 15-minute period	0..900	15	Value for SES in a 15-minute period, above which an urgent alarm is switched on
Threshold value of switching off an urgent alarm after SES was exceeded in a 15-minute period	0..900	0	Value for SES in a 15-minute period, below which an urgent alarm is switched off.
Threshold value of switching on an urgent alarm after SES was exceeded in a 24-hour period.	0..86400	1440	Value for SES in a 24-hour period, above which an urgent alarm is switched on
Threshold value of switching off an urgent alarm after SES was exceeded in a 24-hour period	0..86400	0	Value for SES in a 24-hour period, below which an urgent alarm is switched off
Threshold value of switching on a non-urgent alarm after ES was exceeded in a 15-minute period	0..900	120	Value for ES in a 15-minute period, above which a non-urgent alarm is switched on
Threshold value of switching off a non-urgent alarm after ES was exceeded in a 15-minute period.	0..900	0	Value for ES in a 15-minute period, below which a non-urgent alarm is switched off.
Threshold value of switching on a non-urgent alarm after ES was exceeded in a 24-hour period	0..86400	11520	Value for ES in a 24-hour period, above which a non-urgent alarm is switched on
Threshold value of switching off a non-urgent alarm after ES was exceeded in a 24-hour period	0..86400	0	Value for ES in a 24-hour period, below which a non-urgent alarm is switched off

### 5.5.2.3 15-minute and 24-hour registers

These panels allow the operator to monitor ES, SES, SESFE, BBE and UAS counter values in 15-minute and 24-hour periods, respectively. The "alarm" columns show the type of

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an alarm generated by exceeding an appropriate switch-on threshold (which is set up in the Set-up panel). The device stores 16 records of 15-minute counters for each interface and 2 records of 24-hour counters for each interface. Data is recorded only for non-zero counter values.

REGISTERS 24H				2004.01.01				0:21:43			
Name : TM-77.1		Local address:		014D00FB		Remote address:					
DATE	TIME	ES	ALARM	SES	ALARM	SESFE	ALARM	BBE	UAS		
2004:01:01	00:21	00000	NONE	00000	NONE	00000	NONE	00000	24852		
2003:01:04	00:00	00000	NONE	00000	NONE	00000	NONE	00000	86400		

**Figure 17.** 24-hour registers

### 5.5.3 Time periods

This panel is used to monitor ES, SES, BBE rates in any two time periods specified by the operator.

PERIODS		2004.01.01	0:22:12_
Name : TM-77.1	Local address:	014D00FB	Remote address: [REDACTED]
		Period I	Period II
Start counting	:	2003.01.01 0:00	2003.01.01 0:00
End counting	:	2003.01.01 0:00	2003.01.01 0:00
ESR counter	:	0.0000E+00	0.0000E+00
SESR counter	:	0.0000E+00	0.0000E+00
BBER counter	:	0.0000E+00	0.0000E+00

**Figure 18.** Time periods

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#### 5.5.4 Event log

This panel displays events concerning the device. The types of recorded events are described in paragraph 3.6.

This panel allows the user to delete all events recorded in the device memory using the CTRL+R key combination.

EVENT LOG	2004.01.01	0:23:37_
Name : TM-77.1	Local address:	014D00FB Remote address: [REDACTED]
events in the log : 00042 screen : 00001/00004		
2004.01.01 0:00:13 Power supply appearance 2003.01.05 9:54:03 Loss of power supply 2003.01.05 9:53:54 Power supply appearance 2003.01.05 7:53:12 Loss of power supply 2003.01.05 7:53:03 Power supply appearance 2003.01.05 5:39:14 Loss of power supply 2003.01.05 5:38:49 AIS detected in E1(4), from the remote device 2003.01.05 5:38:49 Loss of signal E1(4) 2003.01.05 5:38:40 Loss of AIS in E1(4), from the remote device 2003.01.05 5:38:36 AIS detected in E1(3), from the remote device 2003.01.05 5:38:36 Loss of signal E1(3) 2003.01.05 5:38:30 Loss of AIS in E1(3), from the remote device 2003.01.05 5:38:25 AIS detected in E1(1), from the remote device		
BkSp-Exit ^R-Log erase up/down-move		

**Figure 19.** Event log

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### 5.5.5 Monitoring

This panel displays parameters, which represent the current status of E1 and E2 interfaces:

- interface defect and anomaly monitoring points,
- transmission quality monitoring objects related to individual interfaces. The meaning of individual indicators is described in paragraph 3.6.

MONITORING				2004.01.01	0:24:31
Name : TM-77.1				Local address: 014D00FB	Remote address: [REDACTED]
<b>LOOS LDF LOF 10E-3 10E-6 RAL</b> ES15 SES15 SESFE15 ES24 SES24 SESFE24					
LOES : 1 2 3 4 VIOL : 1 2 3 4 AISL : 1 2 3 4 AISR : 1 2 3 4					
ES15 : 1 2 3 4 SES15 : 1 2 3 4 ES24 : 1 2 3 4 SES24 : 1 2 3 4					
<b>UALD UALAD NUALD NUALAD</b>					
BkSp-Exit Space-Alarm acknowledge					

**Figure 20.** Monitoring

### 5.5.6 Loops

TM-77 multiplexer terminal is capable of activating test loops from the side of E1 and E2 interfaces. The test loops are described in paragraph 3.3 *Test loops*.

LOOPS	2004.01.01	0:25:12																		
Name : TM-77.1	Local address: 014D00FB	Remote address: [REDACTED]																		
<table><tr><td>interface E1 (1)</td><td>Inactive</td><td></td></tr><tr><td>interface E1 (2)</td><td>Inactive</td><td></td></tr><tr><td>interface E1 (3)</td><td>Inactive</td><td></td></tr><tr><td>interface E1 (4)</td><td>Inactive</td><td></td></tr><tr><td>interface E2 (5)</td><td>Inactive</td><td></td></tr><tr><td>interface E2 (6)</td><td>Inactive</td><td></td></tr></table>			interface E1 (1)	Inactive		interface E1 (2)	Inactive		interface E1 (3)	Inactive		interface E1 (4)	Inactive		interface E2 (5)	Inactive		interface E2 (6)	Inactive	
interface E1 (1)	Inactive																			
interface E1 (2)	Inactive																			
interface E1 (3)	Inactive																			
interface E1 (4)	Inactive																			
interface E2 (5)	Inactive																			
interface E2 (6)	Inactive																			
																				
BkSp-Exit Space-Activate/Deactivate loop up/down-move																				

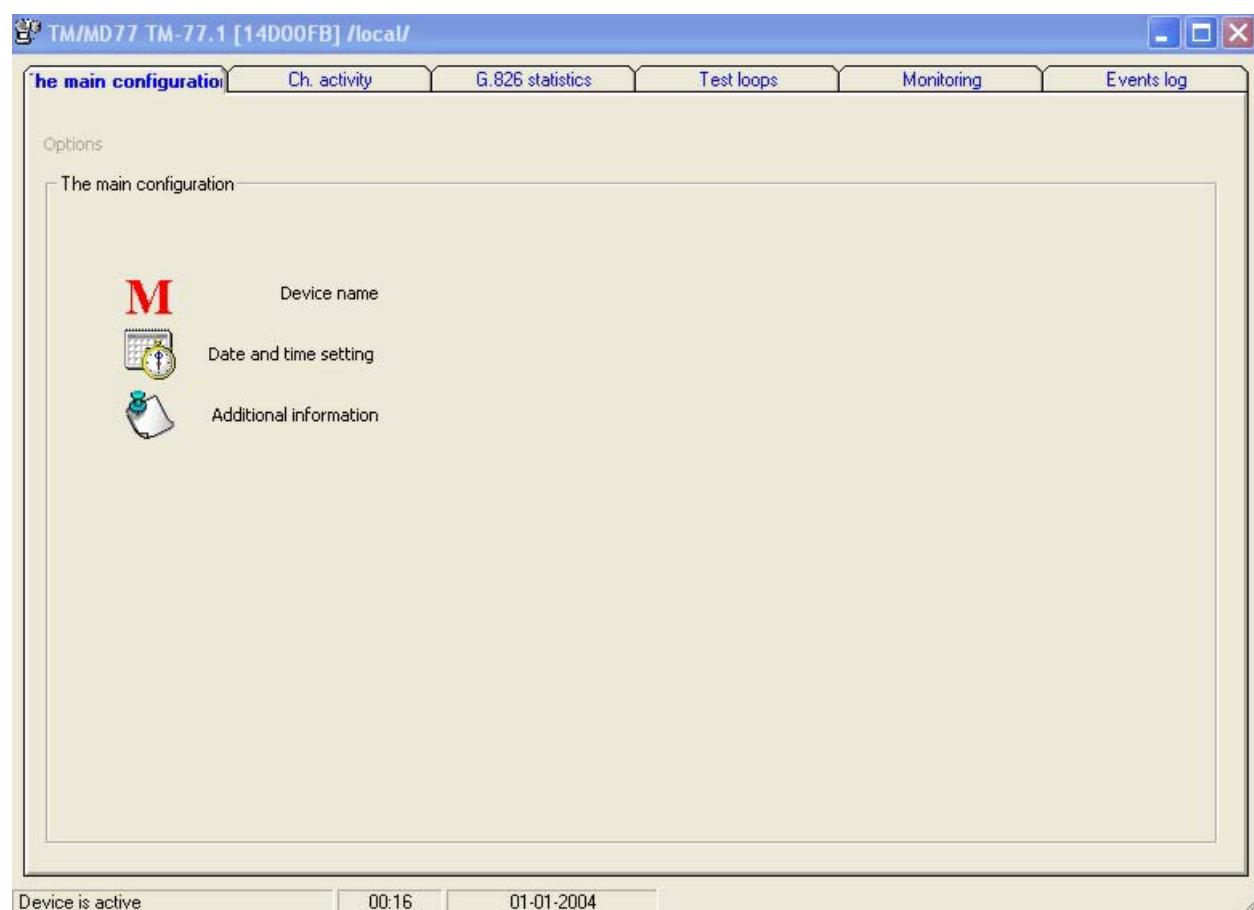
**Figure 21.** Loops

## **6 DEVICE SET-UP USING LANWIN PROGRAM**

The **Lanwin** application in a local version enables the user to supervise and monitor TM-77 in a desktop version and TM-72 racks equipped with MD-77 multiplexer cards. The description of computer connection is given in paragraph 4.5 *Connection to VT100 terminal or computer equipped with LanWin management software.*

### **6.1 Global set-up**

This tab allows the user to enter the name of the device, to set the system date and time and to view additional device information.



**Figure 22.** Global set-up

### **6.1.1 Device name**

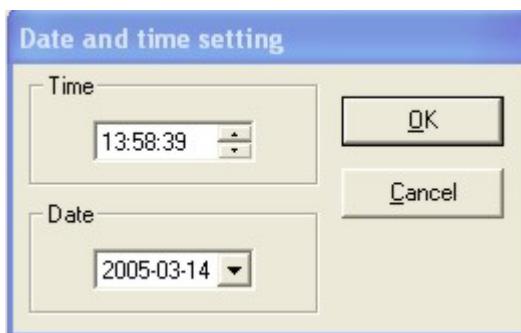
By pressing the "Device name" button you will open a window, in which you can enter its name. During the operation, the entered name will appear in the active device window and in the window of the device, whose name was modified.



**Figure 23.** Device name

### **6.1.2 Setting date and time**

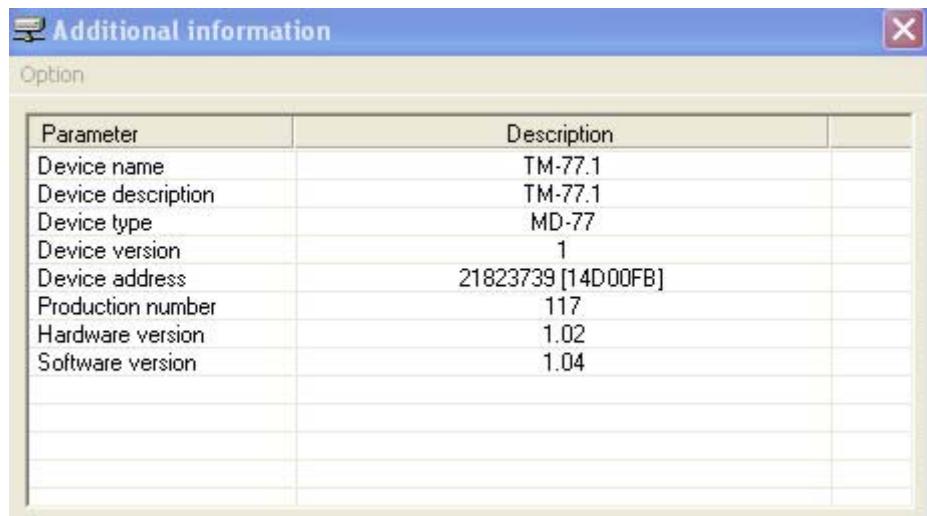
If you press the "Setting time and date" button, the following window will open.



**Figure 24.** Setting date and time After you make any modifications and press the "OK" key, the system time and date parameters of the device will be updated.

### **6.1.3 Additional information**

If you press the "Additional information" button, a window will open showing additional information concerning the connected device.



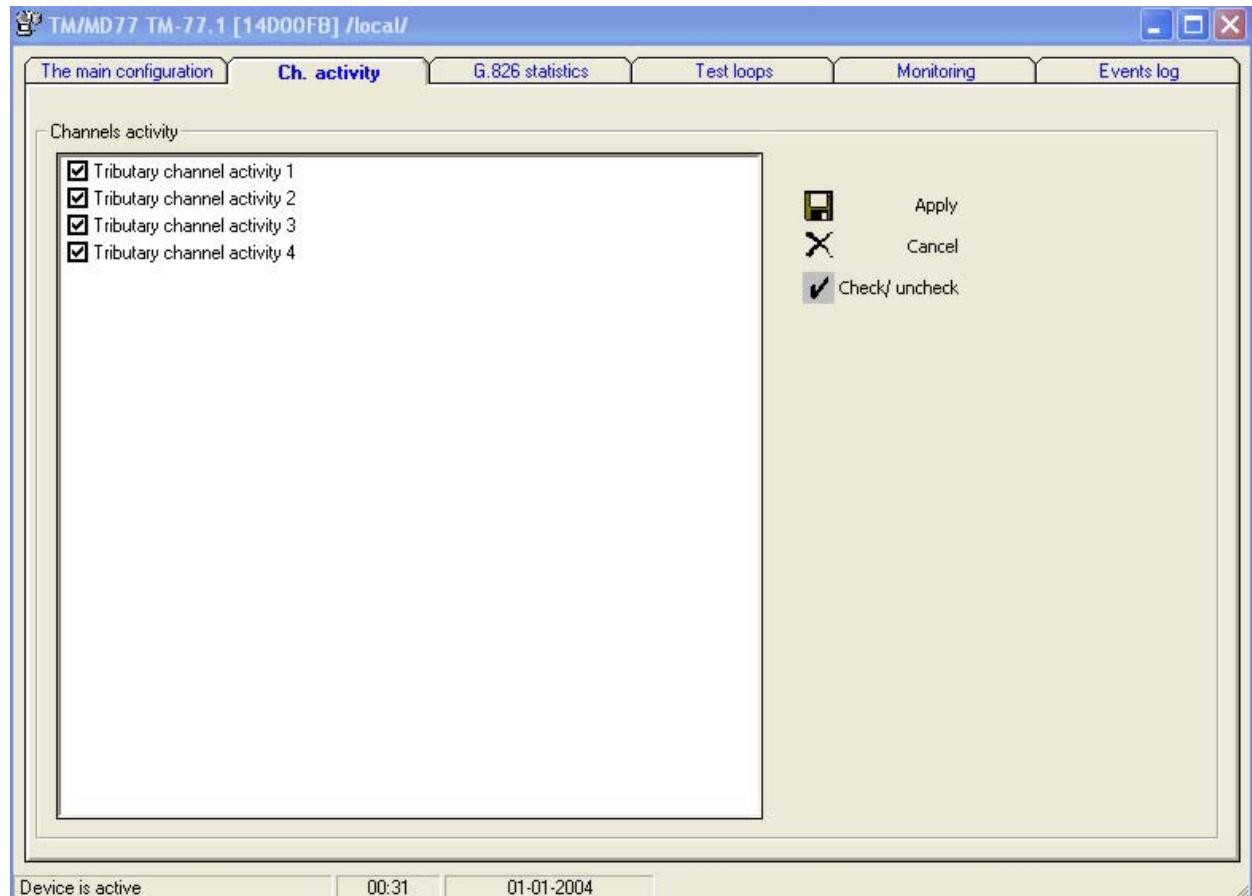
The screenshot shows a Windows-style dialog box titled "Additional information". The title bar has a blue header with the title and a close button. Below the title bar is a toolbar with a single button labeled "Option". The main area is a table with two columns: "Parameter" and "Description". The table contains the following data:

Parameter	Description
Device name	TM-77.1
Device description	TM-77.1
Device type	MD-77
Device version	1
Device address	21823739 [14D00FB]
Production number	117
Hardware version	1.02
Software version	1.04

**Figure 25.** Additional information

## 6.2 Channel activity

The "Channel activity" tab allows the user to switch on and off a single E1 transmission channel. If you switch off a channel, it will block transmission in the channel and deactivate all alarm criteria associated with the channel.



**Figure 26.** Channel activity

## 6.3 G.826 statistics

This tab enables the user to monitor the following numbers in 15-minut and 24-hour periods:

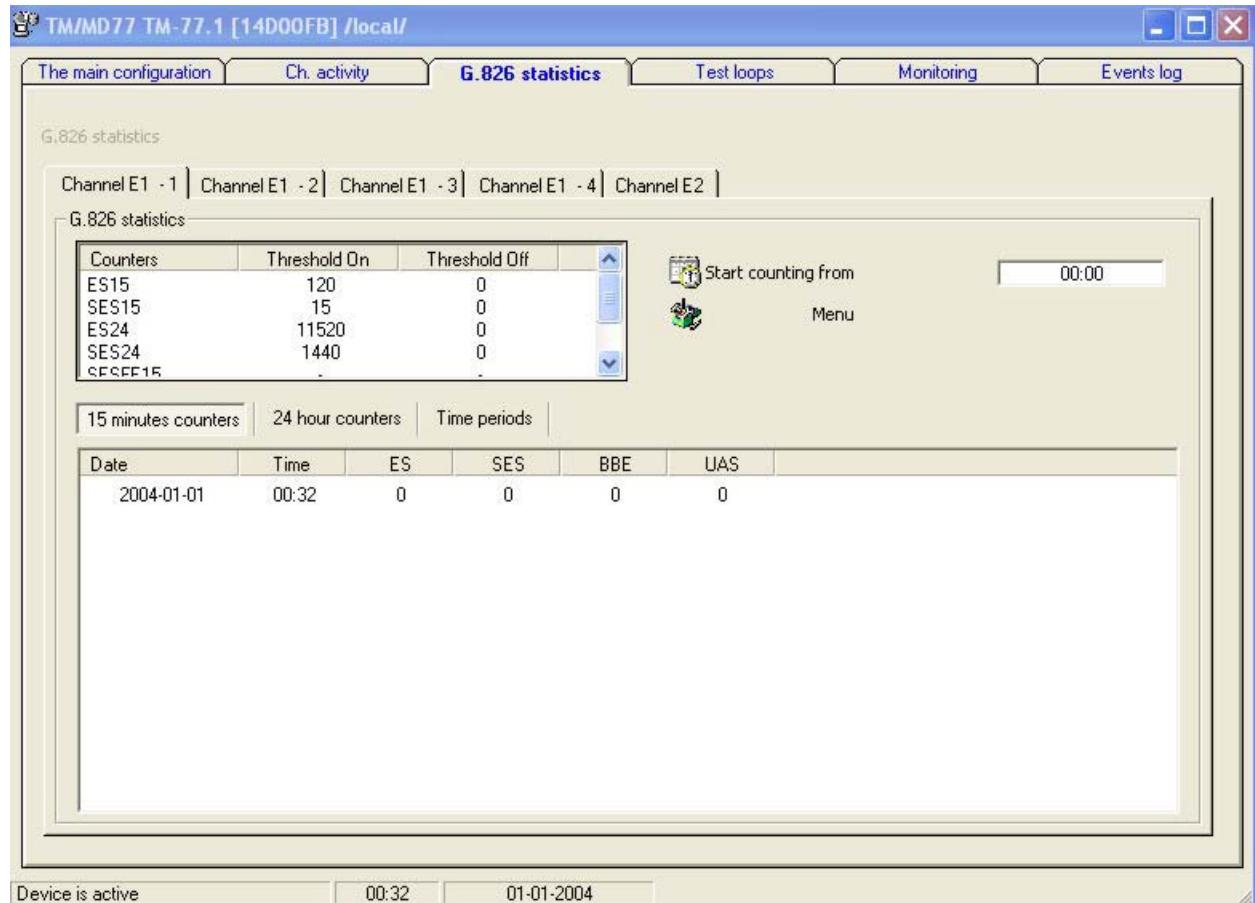
- ES errored seconds,
- SES severely errored seconds,
- EB errored bloks,
- UAS unavailability seconds,

Additionally, you can set threshold values for switching on and off the alarms for SES15, SES24, ES15, ES24, SESFE15, SESFE24 counters, based on which event log entries and alarms are generated. Each counter has an associated alarm severity level identifying the type of a generated alarm.

The user can set the following alarm severity levels:

- urgent alarm,
- non-urgent alarm,
- no alarm.

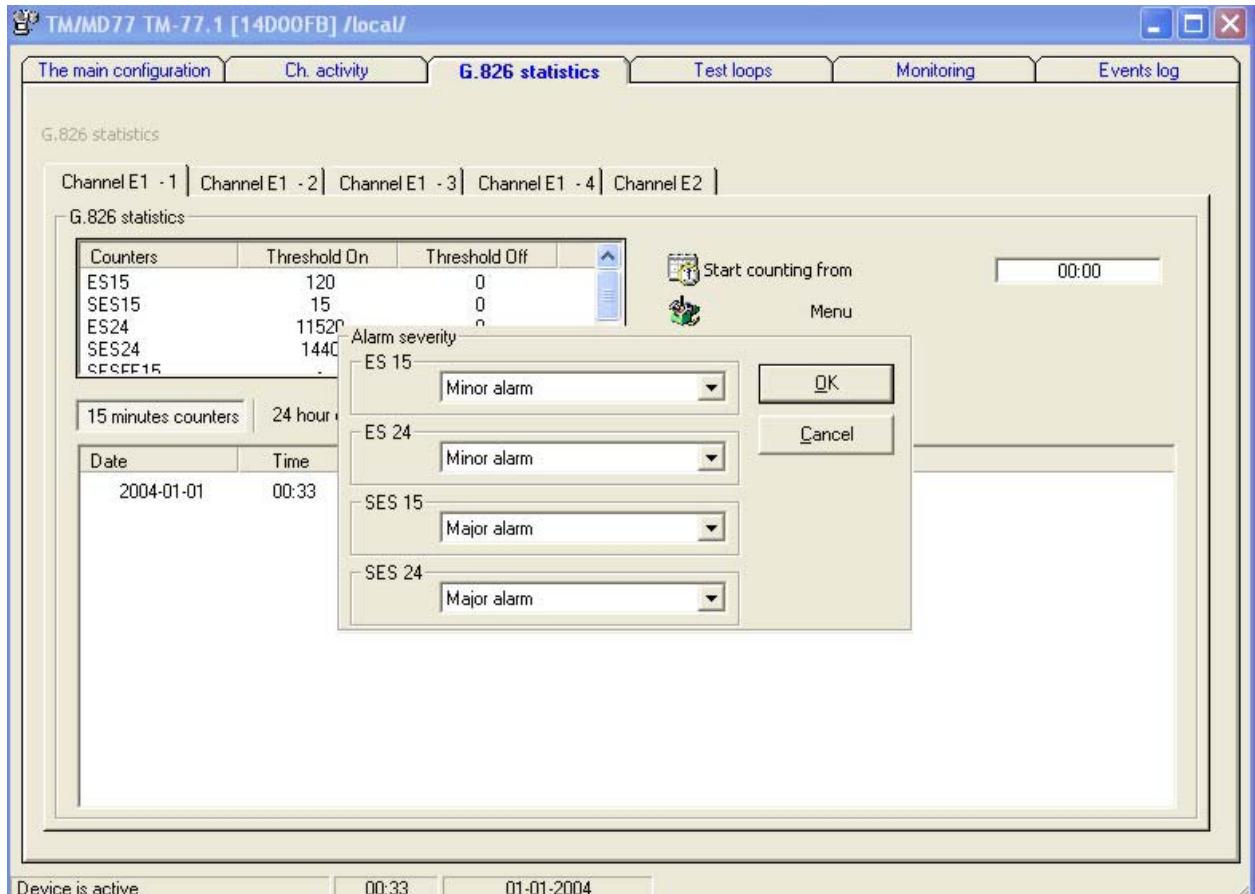
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**Figure 27.** G.826 statistics

### 6.3.1 Alarm severity level

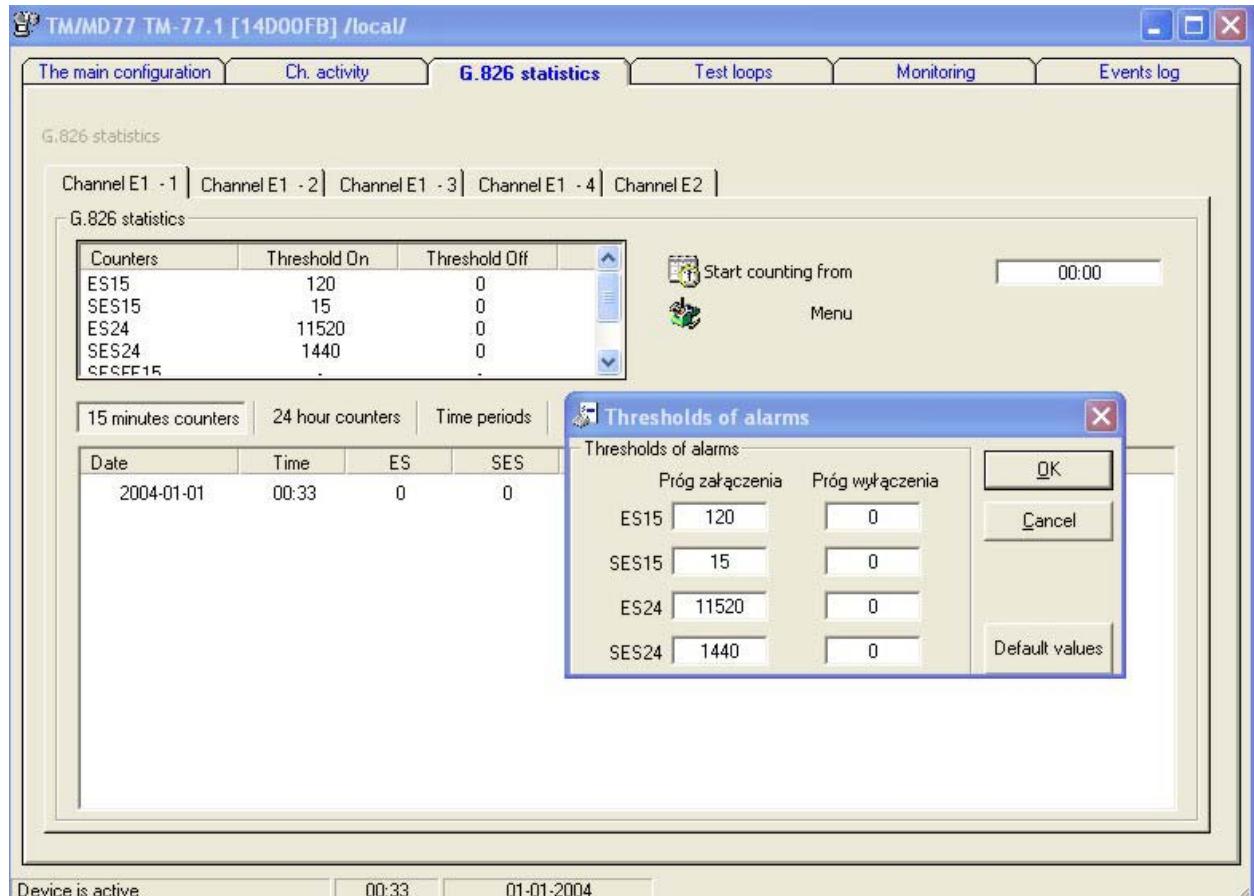
The window shown below allows you to set an alarm severity level. The window will open if you select the "Alarm severity level" option from the Menu.



**Figure 28.** G.826 statistics, Alarm severity level

### 6.3.2 Alarm thresholds

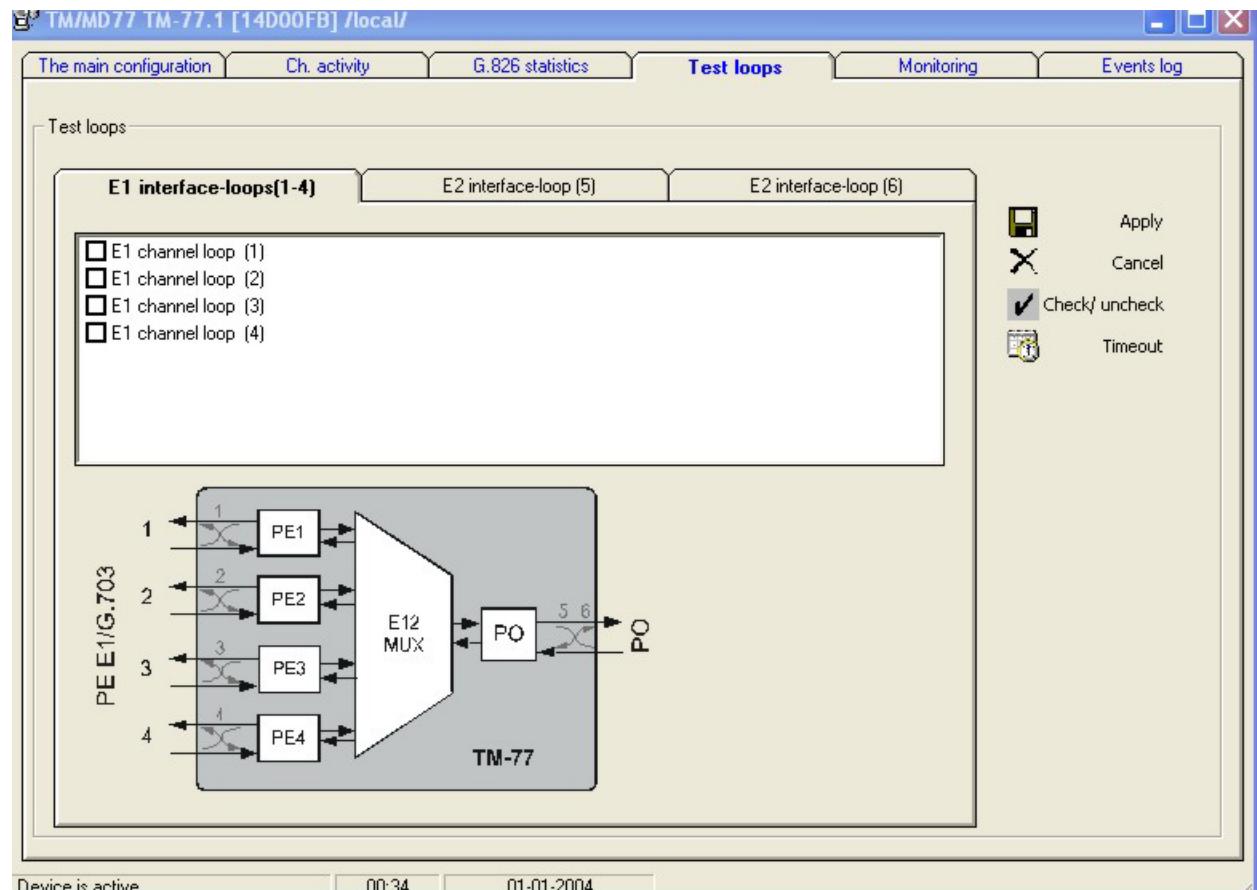
The window shown below allows you to set an alarm switch-on and switch-off threshold. The window will open if you select the "Threshold set-up" option from the Menu.



**Figure 29.** G.826 statistics, Alarm thresholds

#### 6.4 Test loops

The tab "TM-77 test loops" allows you to activate the test loops from the side of E1 and E2 interfaces. The test loops are described in paragraph 3.3 *Test loops*.



**Figure 30.** Test loops

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## 6.5 Monitoring

This panel displays parameters, which represent the current status of E1 and E2 interfaces:

- interface defect and anomaly monitoring points,
- transmission quality monitoring objects related to individual interfaces. The meaning of individual indicators is described in paragraph 3.7.

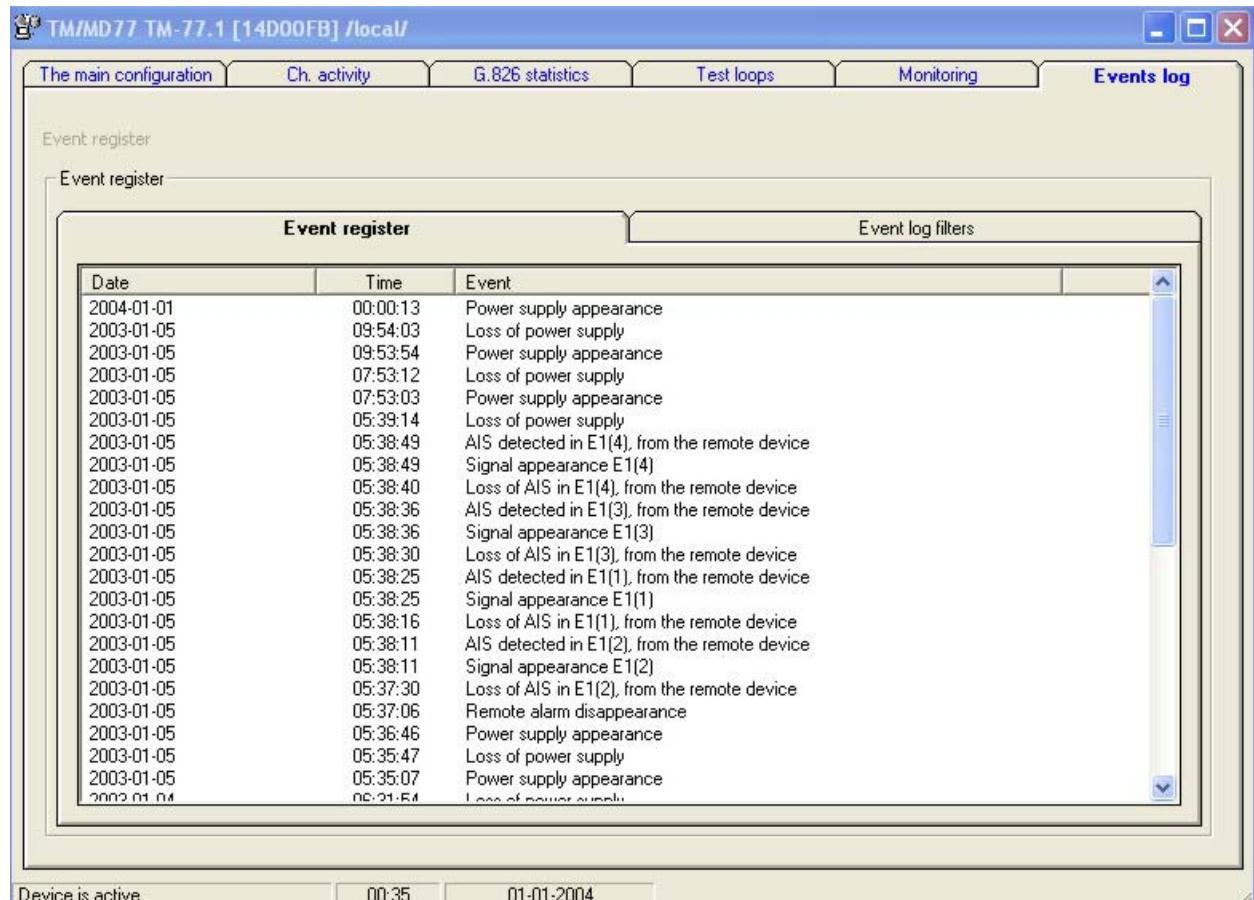


**Figure 31.** Monitoring

## 6.6 Log

### 6.6.1 Event log

The "Event log" tab displays the recorded events concerning the multiplexer. The types of recorded events are described in paragraph 3.5. This tab allows you to delete the complete list of recorded events. You can do this by clicking the right mouse button (when the cursor is placed in this window) and selecting the "Delete the log" command.



**Figure 32.** Log

### 6.6.2 Event log filter

This tab is divided into two parts. The top part of the tab displays events, which are the result of the filtering of all recorded events (displayed in the "Event log" tab). The left bottom part of the window shows three component tabs. They allow you to select the event filtering criteria.

#### List of filtering criteria tabs

- **Events**

It allows you to select and display only events of one type from the above list of recorded events.

- **Date**

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It allows you to select an event filtering time criterion. This tab enables you to select the start and end date and time of this criterion.

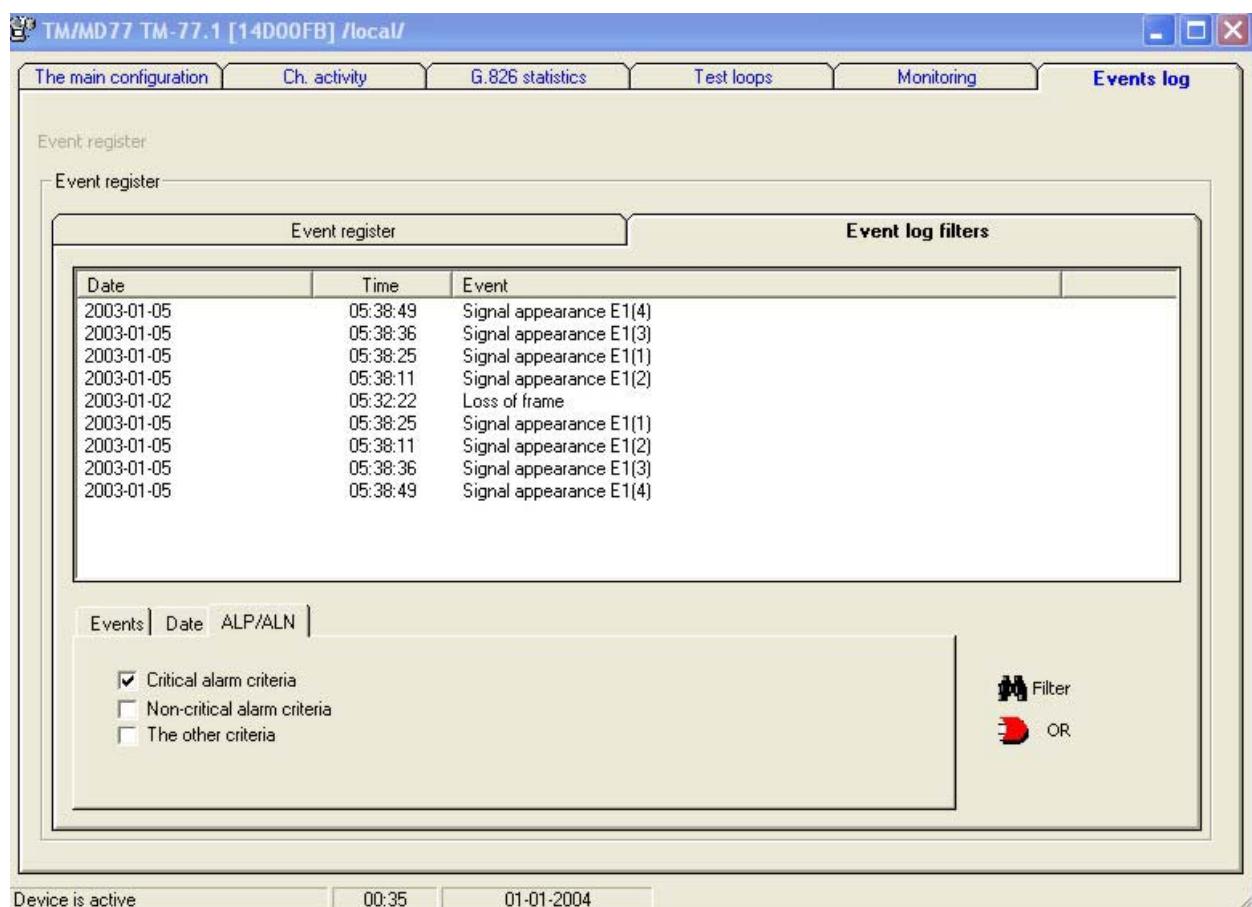
• **UAL/NUAL**

It allows you to select criteria of the displayed events analogous to the ones specified for:

- Urgent alarm criteria (paragraph 3.1),
- Non-urgent alarm criteria (paragraph 3.1),
- other criteria (not included in the urgent and non-urgent alarm criteria).

The following two buttons are displayed in the right part of the window:

- "Filter" - it displays events of the type and value such as in the tab on the left.
- "OR" - it displays events using the criteria from all tabs.



**Figure 33.** Event log filter

## **7 TECHNICAL SPECIFICATION**

### **7.1 Electrical characteristics of E1/G.703 interface**

Parameter or feature	Parameter value or feature description
Electrical compatibility standard	ITU-T G.703
Rated binary bit rate	2.048 Mbit/s $\pm 50$ ppm
AIS signal binary bit rate	2.048 Mbit/s $\pm 50$ ppm
Input and output impedance	120Ω - symmetric connector
Maximum cable attenuation coefficient for 1024kHz frequency	6 dB
Linear code	HDB-3
Error rate	$\leq 10^{-9}$ <sup>1)</sup>
Connector type	DSUB-25

<sup>1)</sup> at the power level at the receiver input not lower than the value specified in paragraph 7.2 as "receiver sensitivity"

## 7.2 Optical interface characteristics

Parameter or feature	Version Symbol	Parameter value or feature description
Linear code	TM 77.1-X MD 77.1-X	5B-6B
Optical signal modulation speed	TM 77.1-X MD 77.1-X	10.1376 Mbod
Optical transmitter type	TM 77.1-3-X MD 77.1-3-X	Laser diode 1310 nm
	TM 77.1-4-X MD 77.1-4-X	Laser diode 1550 nm
	TM 77.1-5-X MD 77.1-5-X	Laser diode 1310 nm
	TM 77.1-6-X MD 77.1-6-X	Laser diode 1550 nm
Level of power optical transmitter	TM 77.1-3-1 MD 77.1-3-1	-15 dBm
	TM 77.1-3-2 MD 77.1-3-2	-5 dBm
	TM 77.1-4-1 MD 77.1-4-1	-5 dBm
	TM 77.1-5-1 MD 77.1-5-1	-14 dBm
	TM 77.1-5-2 MD 77.1-5-2	-8 dBm
	TM 77.1-6-1 MD 77.1-6-1	-14 dBm
	TM 77.1-6-2 MD 77.1-6-2	-8 dBm
	TM 77.1-3-1 MD 77.1-3-1	-35 dBm <sup>1)</sup>
Receiver sensitivity (minimum value for error rate $\leq 10^{-9}$ )	TM 77.1-3-2 MD 77.1-3-2	-36 dBm <sup>1)</sup>
	TM 77.1-4-1 MD 77.1-4-1	-35 dBm <sup>1)</sup>
	TM 77.1-5-1 MD 77.1-5-1	-31 dBm <sup>1)</sup>
	TM 77.1-5-2 MD 77.1-5-2	-34 dBm <sup>1)</sup>
	TM 77.1-6-1 MD 77.1-6-1	-31 dBm <sup>1)</sup>
	TM 77.1-6-2 MD 77.1-6-2	-34 dBm <sup>1)</sup>
	TM 77.1-X MD 77.1-X	SC/PC

### 7.3 Mechanical parameters

<b>Symbol</b>	<b>Feature</b>	<b>Value</b>	
TM-77.1	Width	224.5 mm	
	Height	52.5 mm (incl. feet)	
	Depth	238	
	Weight	1.3 kg	
		<b>Digital card</b>	<b>Interface card</b>
MD-77.1	Width	20.5 mm	20.5 mm
	Height	130.5 mm	130.5 mm
	Depth	147 mm	148 mm
	Weight	0.16 kg	0.17 kg

### 7.4 Environmental requirements

#### 7.4.1 Operation

The devices may operate in unevenly heated closed rooms in the following environmental conditions:

<b>Environmental Parameter</b>	<b>Allowable value</b>
Ambient temperature	+5 ÷ +40°C
Air relative humidity	≤ 80% at +20°C

#### 7.4.2 Transport

The devices should be transported in the original packaging in the following conditions:

<b>Environmental Parameter</b>	<b>Allowable value</b>
Ambient temperature	-25 ÷ +40°C
Temperature change rate	≤ 10°C/h
Maximum air humidity	95%
Atmospheric pressure	700 ÷ 1060 hPa
Multiple surges	5 ÷ 15 g in time of 10 ms

### 7.4.3 Storage

The devices should be stored in closed rooms in the following environmental conditions:

Environmental Parameter	Allowable value
Ambient temperature	-25 ÷ +55°C
Humidity	5% up to 90% below +40°C
Vibrations	frequency: 10 Hz up to 55 Hz, amplitude: 0.15 mm duration: 10 cycles in three planes
Degree of contamination	typical home or office environment

### 7.5 Electromagnetic compatibility

The devices comply with the requirements for class B equipment concerning radioelectric disturbance emissions, set out in PN-EN 55022 standard, *provided that they are installed in accordance with this Manual.*

### 7.6 Power supply

Parameter or feature	Version Symbol	Parameter value or feature description
Rated power supply voltage for device with typical power supply unit	TM-77.1	50 ÷ 60 Hz; 230 V
Rated power supply voltage	TM-77.1	0 Hz; 18 ÷ 60 V
Input current at 230 V/AC voltage	TM-77.1	40 mA
Input current at 36 V/DC voltage	TM-77.1	145 mA
Input current at 60 V/DC voltage	TM-77.1	90 mA
Input current at 18 V/DC voltage	MD-77.1	220 mA
Input current at 60 V/DC voltage	MD-77.1	65 mA
Types of connectors	TM-77.1	double (screw) clamp connector to connect 36-60V DC power supply source  IEC320 / EN 60320 standard device connector to connect 230V AC power supply source

## **8 COMPLETE PRODUCT**

The complete set of the TM-77 desktop multiplexer supplied to the customer includes the following components:

1. TM-77 multiplexer	1 pce.
2. RS-232 cable, DSUB-9 ⇔ RJ-45	1 pce.
3. IOA-77x Operating Manual	1 pce.
4. Guarantee card	1 pce.

for MD-77 rack card:

1. MD-77 multiplexer (digital card + interface card)	1 pce.
2. IOA-77x Operating Manual	1 pce.
3. Guarantee card	1 pce.





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**Lanex S.A. 2007**